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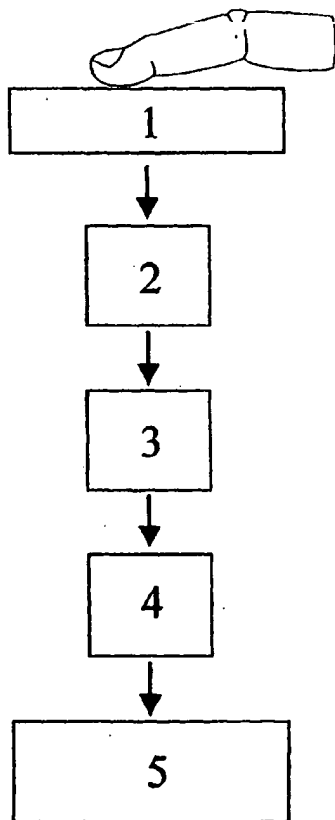
(57) Abstract: The invention relates to a sign generator, as well as method and system comrpsing this, especially for cellular phones including at least one touch or pressure activated switch and a display, analysing means for measuring the connection periods and categorising the periods into at least two categories, storage means for storing sequences of the categorised periods, and translating means for translating said stored sequences into signs according to a predetermined table and indicating the signs on the display.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Character input using a fingerprint sensor

This invention relates to use of a sign/character
generator represented by a fingerprint sensor with
5   navigation means, for text/sign input to communication
devices with displays, such as cellular phones, palmtop PCs,
PDAs, etc.
Recently there has been an enormous growth in the use
of SMS (Short Message System) for text transmissions between
10   cellular phones. The limited size of such phones does,
however, represent constraints to the size of keyboards,
causing generation of text/character input to the phone to
be a slow and cumbersome process. Normally cellular phones
have reduced keyboards with a limited number of keys,
15   normally far less than the normal letters of the alphabet.
The solution of present mobile phones is to let each number
key represent 3 or 4 subsequent letters. Refer figure 1. For
example the key usually giving number 6 will in the
alphanumeric mode define one of the letters m, n or o,
20   pending the number of times the key is pressed. Thus the
word "hello" may be written by pressing key number 4 twice,
key number 3 twice, key number 5 thrice, key number 5 thrice
and key number 6 thrice, thus pressing the keys a total of
13 times. The user needs to memorise the positions of these
25   alphanumeric keys, or look up their positions and shift
finger position from key to key, as per the above example.
One manufacturer, Ericsson, provides an external QWERTY
keyboard as a plug-in device to their cellular phones. This
solution has, however, the disadvantages of extra size,
30   weight and costs, being directly contrary to user requests
for increasingly smaller, lighter, cheaper and more
versatile cell phones.
Another known solution is the Nokia Naviroller™ in
which a mechanical barrel on the front panel is rolled by
35   the finger, bringing up a vertical column of signs and
characters on the display. Selection of a particular sign or
character is performed by mechanically pressing down the
barrel. In practice this is not a faster solution than

moving the finger from key to key and pressing the selected
key one or multiple times. The Naviroller™ solution also
imposes a serious constrain on the cursor movements as it
limits cursor movements to one dimension; <up> and <down>,
5   except for pressing the barrel for character selection.

Tegic Communications has developed a system called T9™
whereby software logic search for legal letter combinations
of a particular language, thereby minimising the multiple
presses of any key representing multiple characters, as
10 shown in figure 1. This is an elegant solution as the number
of finger taps is presumably significantly reduced, but the
negative aspect is that it requires a translation program
for each language, and that these must be stored in the
phone memory. Motorola is said to have developed a similar
15 solution, called iTap™, thus having the same problems.

Sign handling of another known type is the Zi 8™
provided by ZiCorp, to facilitate character input by Chinese
signs through a limited keyboard, as shown in figure 1. It
is based on the fact that Chinese signs are composed of so
20 called basic strokes, which sequence defines a particular
sign. These basic strokes are assigned to the keys, much in
a similar way as the letters are assigned to the number
keys, as shown in figure 1. This solution enables input of
Chinese characters by a regular cellular phone keyboard, as
25 per figure 1, but does not resolve the main problem of using
a keyboard for sign/character input to a communication
device with display. A keyboard is still required, and due
to size limitations it normally contains far less keys than
the characters/signs required to compose a meaningful
30 message. The finger therefore has to be moved around the
keyboard, and each key may need to be pressed down
mechanically multiple times to select a message.

US 6,057,540 describes an optical sensor with
navigation utilities. It's dimensions and complexity,
35 however, makes unsuitable for usse in mobile phones and
similar. Also, as the sensor described here preferably uses
a 16x16 pixel matrix it is not suitable for use as a
fingerprint sensor, since the resolution is unsufficient.

US 5,608,395 describes a telegraph key connected to a

computer for writing text. The characters are organized in
a hierarchy for demanding a minimum memory for choosing each
character. This solution is also to complicated and large
and does not have the advantage of using existing sensors in
5   modile phones or similar.

The above illustrates the present situation for compact
communication devices like cellular phones, where complex
text input is cumbersome as such input has to be generated
through the limited keyboard of figure 1. The next
10   generation of cellular phones comprises so-called WAP phones
with Internet access. In general this development calls for
increased displays, for better readability of the far more
extensive information available to the user. Preferably
increased display size should not increase the cell phone
15   size. The most viable way to increase display size without
increasing the phone size will be to reduce the keyboard
size, preferably to a single row of buttons, comprising e.g.
three or less number of buttons, as shown in fig. 2, but
still enabling complex text input to the cellular phone.
20   None of the above solutions will function satisfactorily
with such a minimum "keyboard".

The Morse alphabet is a known method for convenient and
high-speed text input. It may be used for input to
information/communication devices with comparative large
25   displays and minimised "keyboards" as per fig. 2, provided
one of the keys can be used for Morse sign input. The Morse
code is a very fast and efficient method for standard
characters, such as Latin letters or Arab numbers. However,
it poses serious constrains when it comes to special
30   characters/signs that may either be represented by very long
and cumbersome sequences of dots and dashes, or which are
not included in the standard Morse alphabet at all.

Thus it is an objective of this invention to provide a
method for efficient text input to information/communication
35   devices with minimum keyboards with at least one key, by a
combination of Morse alphabet sign input and character
selection from the display, by finger commands on a touch-
sensitive switch. This solution will supplement the high
input speed of the Morse alphabet with the flexibility of

4

selecting special characters/signs from a display. These
objects are obtained using a sign generator characterized as
described in the accompanying independent claims.

The invention will be described below by way of example
5   and with reference to the accompanying drawings.

Fig. 1 illustrates a traditional reduced keyboard for
cellular phones, with multi-character keys.

Fig. 2 illustrates schematically new cellular phones
with large display and a single sign-generator key, as part
10 of a minimum "keyboard".

Fig. 3 illustrates the invention schematically.

Fig. 4 illustrates categories of finger movements in
two dimensions.

Fig. 5 illustrates schematically the Input Modes that
15 the invention may work under.

Fig. 6 illustrates the use of a preferred embodiment of
the invention to write a message by the Morse alphabet.

Fig. 7 illustrates typical finger command interfacing
with the information/communication device.

20   First the principle of the invention will be described,
followed by a description of simple Morse sign input.
Finally will be described multiple mode input by combination
of simple Morse signs with generating characters from
selection screens on the display, all by finger commands.

25   The principle of the invention is illustrated
schematically in fig. 3. A touch sensitive switch 1 is
coupled to analysing means 2. The analysing means measures
the connection time of the switch and categorises the signal
from the switch into at least two categories, depending on
30 the length of the connection time. The classified categories
of data are stored in a memory 3 and are compared by a
translation means 4 with a predefined table relating input
signal sequences to readable characters/signs. The signs
corresponding to the sequences are then shown in the display
35 5 in a known manner. The form in which the data are
presented on the screen, and how text input is interacted by
the user is controlled by the translation means 4.

In a preferred embodiment of the invention the
categories are translated according to a table comprising

5

the Morse alphabet. Thus the connection categories are
stored as long (dash) and short (dot) signals. According to
one embodiment of the invention the disconnection periods
are also measured in order to distinguish between periods
between the signals, the periods between complete signs and
periods between words.

The connection categories may be selected by measuring
the connection period t_m and comparing them t_{moff} with
predefined limits separating the dots of the Morse alphabet
from the dashes. In addition there should preferably be
lower and upper limits for being registered as a signal.
Signals being shorter than the lowest limit defined as t_{reg}
may be ignored to avoid errors caused by accidental touches
of the switch 1 e.g. due to handling of the
information/communication device. Connection periods longer
than the predefined limits may also be ignored, or may be
classified as a separate code, for example "End of message".
Table 1 defines typical time limits, as follows.

Table 1

Time Ranges	Nom. Values	Meaning	Type
$0,001s < t_{Reg} < 0,100s$	$t_{Reg} = 0,01s$	Reg. limit	Basic/Non-adapt
$1,5\ t_{Req} < t_{Off} < 50,0\ t_{Req}$	$t_{Off} = 0,25s$	Sign Sep.	Adaptive
$1,5\ t_{Req} < t_{Short} < 50,0\ t_{Req}$	$t_{Short} = 0,25s$	Dot	Adaptive
$1,5\ t_{Short} < t_{Long} < 5,0\ t_{Short}$	$t_{Long} = 0,50s$	Dash	Adaptive
$1,5\ t_{Long} < t_{Extra} < 10,0\ t_{Long}$	$t_{Extra} > 0,75s$	Period	Adaptive

In addition long disconnects may be registered as
periods between signs.

The time limits of Table 1 above may of course be
chosen otherwise. A particular embodiment of the invention
is to set the above ranges dynamically to adapt to the
user's skills and his learning curve in using the invention.
This may be done by registering the e.g. 50 last commands of
each type, and calculating the arithmetic mean and standard
deviation. The statistics may be based upon any written text
or a predetermined learning sequence, and may be used to
shift the category definitions according to the speed of the
user, and thus also adapt as the user learns the system and
increases his input speed.

The touch-sensitive switch 1 may in its simplest form

6

be a simple on and off touch sensitive switch. As explained
above the Morse alphabet is a very fast method of generating
standard Latin letters or Arab numbers, as the Morse
alphabet is so constructed that the most frequently used
5   characters are assigned with least numbers of Morse signs
(dashes/dots). Accordingly special characters/signs may be
represented by long and cumbersome sequences of dots and
dashes, or may not be defined at all in the standard Morse
alphabet. Accordingly the preferred embodiment of the
10 invention is to combine the Morse input mode with other
input modes, such as selection of characters from selection
screens in the display by finger commands. In order to
implement a comprehensive and intuitive set of finger
commands in the interpretation/translation means 4 it is
15 necessary to expand the finger commands from vertical taps
of predefined duration categories (dots and dashes) with
lateral finger commands. Accordingly the preferred
embodiment of the invention the switch is also capable of
registering lateral finger movements on the switch. A
20 suitable sensor is described in EP 735.502, which describes
a line shaped fingerprint sensor. The fingerprint sensor
described in this patent publication scans the fingerprint,
and in order to be able to analyse the finger-print, is able
to detect the finger movement across the sensor. Thus such
25 sensors are able to both detect the finger as it touches the
sensor, and to detect a lateral finger movements. For
example a finger movement across the sensor may be used to
indicate separation between two letters, while another
movement may be used to separate two words. Another
30 incentive for this preferred embodiment of the invention by
using a fingerprint sensor capable of also registering
lateral movements (fingerprint sensor with navigation means)
is that information/communication devices in most cases
contain privileged and proprietary information which might
35 be highly sensitive. It is therefore beneficial to protect
access to the device by biometrics such as identity verifi-
cation by fingerprints. Accordingly the combined use of a
fingerprint sensor with navigation means for both text input
and for identity verification in a single sensor will be

very cost-efficient. The benefit of such a combined solution
will further minimise the size of the keyboard, to maximise
the display size, as illustrated by fig. 2.

This preferred embodiment of the invention using a
5   single sensor for text input generation (by Morse signs, or
by selecting characters/signs from the display) by finger
commands and for access control by fingerprint biometrics is
therefore cost-efficient and enables larger display size.
Fig. 4 illustrates the preferred embodiment of the invention
10   in which the switch 1 is capable of measuring finger
movements in two dimensions. This may for example be
obtained by using two orthogonal sensors of the type shown
in the EP publication mentioned above. The figure
illustrates categories of lateral finger movements that are
15   used to build finger commands, either by basic finger moves,
or combinations thereof. Fig. 4 defines ten lateral finger
movement categories (in addition to vertical taps); eight
directions of movements and two circular movements
(clockwise and counter-clockwise). These may also be
20   combined with time measurements to calculate the velocity of
a movement, thus providing a number of differing categories
from one single finger movement.

Such a combined sensor enables the invention to use
comprehensive finger commands (with time measurements) in
25   both the vertical direction (taps) and the horizontal
directions (lateral finger motions). It is a key issue of
this invention that such comprehensive finger commands are
capable of providing convenient and flexible text input in
both Morse mode and all other input modes, such as character
30   selection by finger commands directly from the display.
Typical examples of input modes by the invention are
illustrated in fig. 5. This requires a finger command
structure that is applicable to all input modes. Moreover
the finger command structure must be intuitive within each
35   input mode, to avoid the need for memorising complex finger
commands. Such a finger command structure is exemplified in
Table 2 below.

Table 2
Finger Command Structure

8

Display Mode Commands			
Vertical Screen Input Commands (One-character wide vertical Selection Fields)		Horizontal Screen Input Commands (One-line high Command Fields or Option Fields)	
Select Character	<Double Tap>	Select Command/option	<Double Tap>
One position down	<Finger Down>	One line down	<Finger Down>
Scroll down	<Finger Down - Hold>	Scroll down	<Finger Down - Hold>
One position up	<Finger Up>	One line up	<Finger Up>
Scroll up	<Finger Up - Hold>	Scroll up	<Finger Up - Hold>

Screen Manipulation Commands			
Toggle to horizontal fields	<Slanted Down Left>	Shift vertical fields	<Finger Right/Left>
Toggle to vertical fields	<Slanted Up Right>	Shift horizontal fields	<Finger Up/Down>
Toggle to/from Edit Text Mode		<Extra Long Tap> - <Finger Down>	

Edit Text Commands			
Home of Text Field	<Slanted Up Left>	Toggle to/from Edit Mode	See Screen Manip. Commands
End of Text Field	<Slanted Down Right>	Mark n characters left	<Long Tap> + n <Short Taps>
Move one position left	<Finger Left>	Mark n words left	<Long Tap> + n <Finger Left>
Scroll left	<Finger Left - Hold>	Shift marked letters' case	<Long Tap>
Move one position right	<Finger Right>	Delete marked character(s)	<Extra Long Tap>
Scroll right	<Finger Right - Hold>	Copy marked character(s)	<Double Tap>
One line up	<Finger Up>	Paste marked character(s)	Two <Double Taps>

Scroll up	<Finger Up – Hold>	Insert space right of cursor	<Short Tap>
One line down	<Finger Down>	Write to right of cursor	*Exit Edit to Input Mode*
Scroll down	<Finger Down – Hold>		

Morse Mode Commands		Global Commands		Sign Language Commands
Dot	<Short Tap>	Shift Input Mode	<Circ. Finger Move>	<Circular Finger Move> brings up Command Field w/ Sign Language Mode. <Double Tap> to select. Then use <Finger Down/Up> for Chinese, Japanese or Korean signs
Dash	<Long Tap>	Toggle Edit Text	*See Screen Commands*	
Sign sep.	<Finger Off; Short>	End of Text Input	Two <Extra Long Tap>	
Char. sep.	<Finger Off; Long>			
Word sep.	<Finger Down>			

The Finger Command Structure is a vital part of the translation means 4 of this invention. The analysing means 2 will register any Input Mode shift command (e.g. <Circular Finger Moves> according to Table 2) and thereby switch between the applicable finger sequence/movement categories applicable to each particular Input Mode. The translation means 4 will thereby interpret the resulting finger movement categories and sequences according to Table 1 and Table 2, and display the resulting sign/character on the display 5.

The invention thus uses a fingerprint sensor with navigation means 1, as touch-sensitive switch with multiple

10

input modes possible in addition to simple Morse sign input.

The preferred embodiment of the invention is exemplified in fig. 2. The information/communication device (cellular phone, palmtop PC, PDA, etc.) comprises a display 5 which size

5   is maximised relative to the overall dimensions of the device. In addition to the display 5 the device contains at least a touch-sensitive switch 1 and e.g. two function keys (6 and 7) that comprises a minimal "keyboard". The same touch-sensitive sensor is also a fingerprint sensor enabling access control to

10 the device by identity verification through fingerprint biometrics.

A typical input example by use of the invention is illustrated in fig. 6. Fig. 6a shows the example text string; "This is a text example." comprising 23 characters including

15 spaces between the words. Fig. 6b shows the text input by Morse finger commands on the switch, using short taps for dots and long taps for dashes of the Morse alphabet according to sequences as per Table 1. Fig. 6b also shows that separation between words is performed by the finger command <Finger

20 Down>. Fig. 6b shows totally 43 finger moves (short and long taps, and words separated by <Finger Down>) to input the text example. However, these finger moves can be very swiftly executed as it only involves vertical movements of the finger, at the same location. Fig. 6d shows the same input by using a

25 reduced keyboard as per fig. 1 with multiple letter representations on each key. The numbers in fig. 6d refer to the key numbers, while the quantity of each number shows how many times each key has to be pressed to select the letter. The arrows at the base of fig. 6d indicate lateral shift of

30 finger positions between the respective keys. From fig. 6d it can be seen that regular input by tapping keys on a reduced keyboard with multiple letter representations requires 41 key taps supplemented by 21 lateral finger position shifts, totalling 62 finger movements, which is about 50 % more finger

35 moves than the same input by the Morse alphabet.

Even more important is it that the invention allows significantly increased display size (for WAP applications) as per fig. 2, as the large keyboard of fig. 1 is replaced by a single sign-generator button supplemented by e.g. two function

keys.

   Fig. 7 illustrates the multiple-mode input versatility of
the invention that enables such single-key versatility. Fig.
7a shows the display 5 of the device, and underneath the
5   touch-sensitive sensor 1 with navigation means, plus two
function keys (6 and 7). The display comprises a vertical
selection field 8 and a horizontal command field 9. Both are
controlled by finger commands on the switch 1. Switching
between the vertical selection field and the horizontal
10   command field is done by intuitive finger commands 10, in this
case <Slanted Finger Down Left> and <Slanted Finger Up Right>
respectively, as illustrated in fig. 7a. Fig. 7b illustrates
sets of vertical selection fields 15; typically special
characters. Arab numbers, capital letters, minor letters, rare
15   letters, Greek letters, etc. Character selection within a
vertical selection field is performed by <Finger Down> or
<Finger Up> commands (refer Table 2 for scroll commands) until
the requested character is in marked position, and then
<Double Tap> for selection and entry of the character into the
20   text on the display 5. Switching between the applicable
vertical selection fields 15 is done by commands 14 <Finger
Left> or <Finger Right> as per fig. 7b. At the base of fig. 7a
is displayed how input mode may be shifted, while typical
input modes are exemplified in fig. 7c. The default mode can
25   be Alphanumeric Input (Latin alphabet) by the Display Mode, as
per fig. 5. The following example illustrates how the user may
shift from this default mode to Chinese sign-based language,
with reference to figs. 7a and 7c. First he makes a <Circular
Finger Move> 11 on the sensor 1. This pops up the horizontal
30   command field of fig. 7a, displaying the default input mode.
The user continues with discrete <Circular Finger Moves>
flipping through the alternative input modes as per fig. 7c
until e.g. the requested alternative Sign-Based Languages is
displayed in the horizontal Command Field 9. He then enters
35   the finger command 12 <Double Tap> on the sensor 1 to confirm
his selection of Sign-Based Languages. He then makes another
finger command 13 <Finger Down> or <Finger Up> to flip through
the alternative sign-based languages, which may comprise
Chinese, Japanese and Korean, as per fig. 7a. The user may now

12

select the signs of the text directly from the vertical
selection field (where they could be arranged in selection
field sets arranged e.g. by first strokes). A preferable
embodiment of the invention is that he selects the Draw Mode
5   (fig. 5) drawing either Zi 8™ reduced strokes, or basic
strokes, or the entire sign directly on the sensor 1. Other
alternative input languages per fig. 7c are e.g. Character-
based Languages (comprising Latin alphabet, Greek alphabet,
Arab or Cyrillic) or Mathematics comprising e.g. arithmetic,
10 trigonometry of differential operations.

In accordance with the above description the invention
comprises the following elements, with reference to fig. 3;

A single input button in the form of a touch-sensitive
switch 1 comprising a fingerprint sensor as e.g. described in
15 EP 735.502, with ability to register connection (and their
duration) (time) of finger on sensor. The sensor will also
register lateral finger movements including direction and
finger speed, through a sensor pattern with associated
movement categories as shown in fig. 4.

20 Analysing means 2 which by "global" finger commands (as
per Tables 1 and 2) will be set in different input modes, each
mode being associated with a particular set of finger movement
categories and sequences which the output signals from the
sensor 1 will be analysed versus and compared to.

25 Storage means 3 which serves as a buffer while the
translation means 4 compare the identified categories and
sequences of finger commands with the Finger Command
Structure, typically as per Table 2.

The translation means 4 also comprises interfacing to the
30 processor of the information/communication device, to print
out the inputted signs/characters on the display 5.

The preferred embodiment of the invention as described
above gives the following three major advantages compared to
other known solutions;

35 -   The touch-sensitive switch 1 with navigation means 1
allows for very fast text input by the Morse alphabet by
a single key, in combination with the predefined sets of
categories and sequences as per Table 1.

-    The combination of the switch 1 used as Morse key, with

13

the Finger Command Structure (Table 2) implemented in the
translation means 4, provides additional versatility and
flexibility. This is because the very fast Morse mode can
be used for standard text input (Latin letters and Arab
5   numbers) while special characters and signs can be
conveniently generated by switching back and fro to the
other input modes, such as e.g. Display Input Mode.
        The touch-sensitive switch 1 with navigation means
provides the combination of a touch-pad, a fingerprint
10   sensor and a text input generator, all in a single
combined button. This is highly cost efficient, and above
all enables reduction of the required keyboard (as per
fig. 2) compared with the traditional solution shown in
fig. 1. This combination can not be achieved by the
15   single-directional NaviRoller™.

14

C l a i m s

1.   Use of a fingerprint sensor in a cellular phone or
similar as a touch or pressure activated switch for writing
signs, the cellular phone further comprising:
        a display for displaying information,
        analysing means for measuring the aktivation periods and
categorising the periods into at least two categories,
        storage means for storing sequences of the categorised
periods, and
        translating means for translating said stored sequences
into signs according to a predetermined table and indicating
the signs on the display.

2.   Use according to claim 1, wherein the lengths of the
disconnection periods are also measured.

3.   Use according to claim 1, wherein the set of categories
comprises the Morse alphabet.

4.   Use according to claim 1, wherein the fingerprint sensor
is a linear fingerprint sensor being sensitive to movements in
at least one direction.

5.   Use according to claim 2, wherein the sensor being
capable of measuring movements in two dimensions, said
analysing means also being capable of categorising said two
dimensional movements according to a chosen set of categories
including the directions and duration of said movements, and
said predetermined table in said translating means including
said set of categories corresponding to chosen signs.

6.   Use according to claim 5, wherein the set of categories
comprises linear movements in at least eight directions and
two circular movements, clockwise and counter-clockwise.

7.   Use according to claim 5, wherein the categories are
organised in a hierarchy, the first finger movement thus
selecting a first set of signs, the second movement selecting
a sign or subgroup from the first set of signs.

8.   Use according to claim 7, wherein the hierarchy has at
least three levels.

9.   Use according to claim 7, wherein the categories define a
Chinese sign set.

10. Method for using a using a fingerprint sensor according
to claim 4 or 5 in which measuring finger movements across the
sensor in at least one dimension,
     using the analysing means for categorising finger
movements across the sign generator according to predefined
sets of finger movement sequences including directional and
touch/no-touch finger movement sequences,
     using the translating means including uniquely defined
command table for translating the categorised finger movements
into signals controlling the display as results of the finger
movements on the sensor.

11. Method according to claim 10, wherein the categories are
ordered in a hierarchy, a first categorised finger movement
thus selecting a first set of signs, the second categorised
movement selecting a sign or subgroup from the first set of
signs.

12. Method according to claim 13, wherein the hierarchy has
at least three levels.

13. Method according to claim 11, wherein the categories
define a Chinese sign set.

14. Method according to claim 10, wherein the finger
movements control cursor movements on the display within the
selected table of characters, signs or commands.

16

15. Method according to claim 14, wherein at least one finger movement controls the selection of the desired character, sign or command which the cursor has been moved to within the selected table.

16. Method according to claim 10, wherein at least two of the categorised movements is related to a control signal for the display, said display indicating a list of signs and said control signal indicating scrolling and choosing in said list or lists.

17. Sign generator system for information/communication devices, comprising a combination of a touch-sensitive fingerprint sensor with navigation means coupled with an analysing means containing sequenced categories of finger commands and coupled to a translation means based on a Finger Command Structure, providing full versatility in text input through a single-key input device.
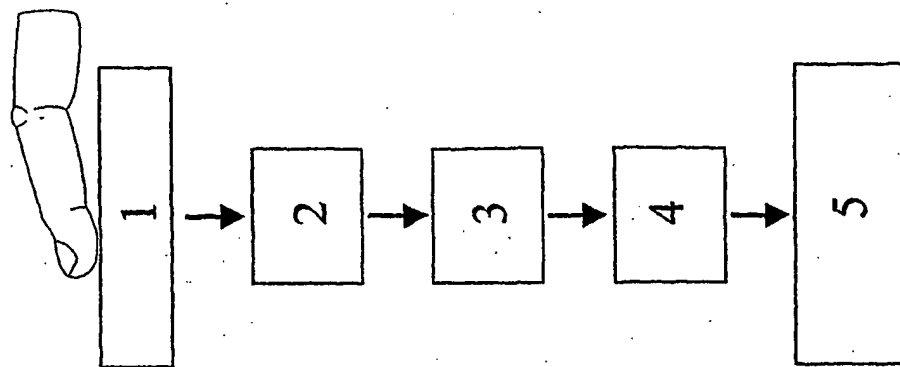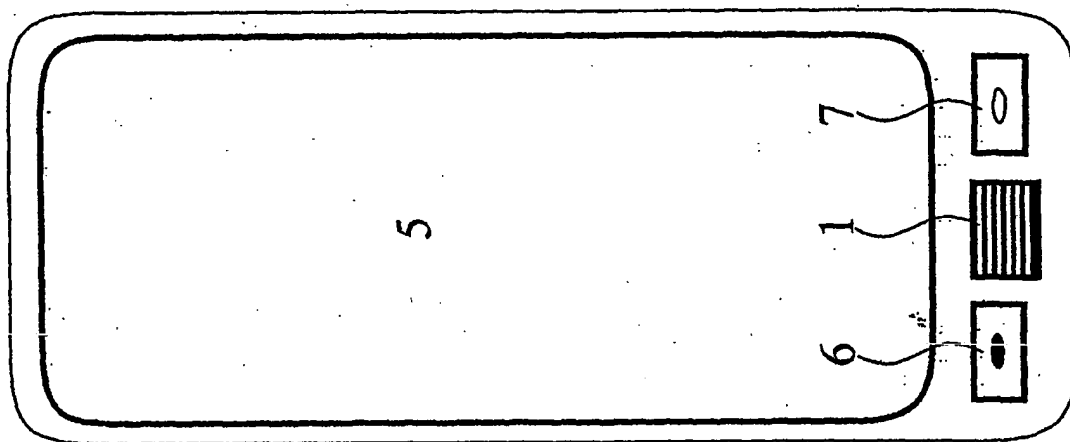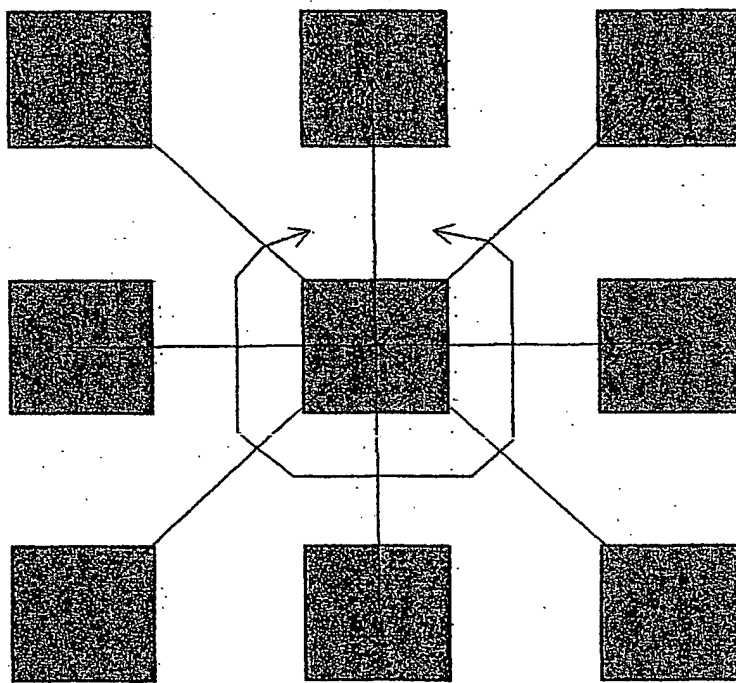
Fig. 3

Fig. 2

Fig. 1
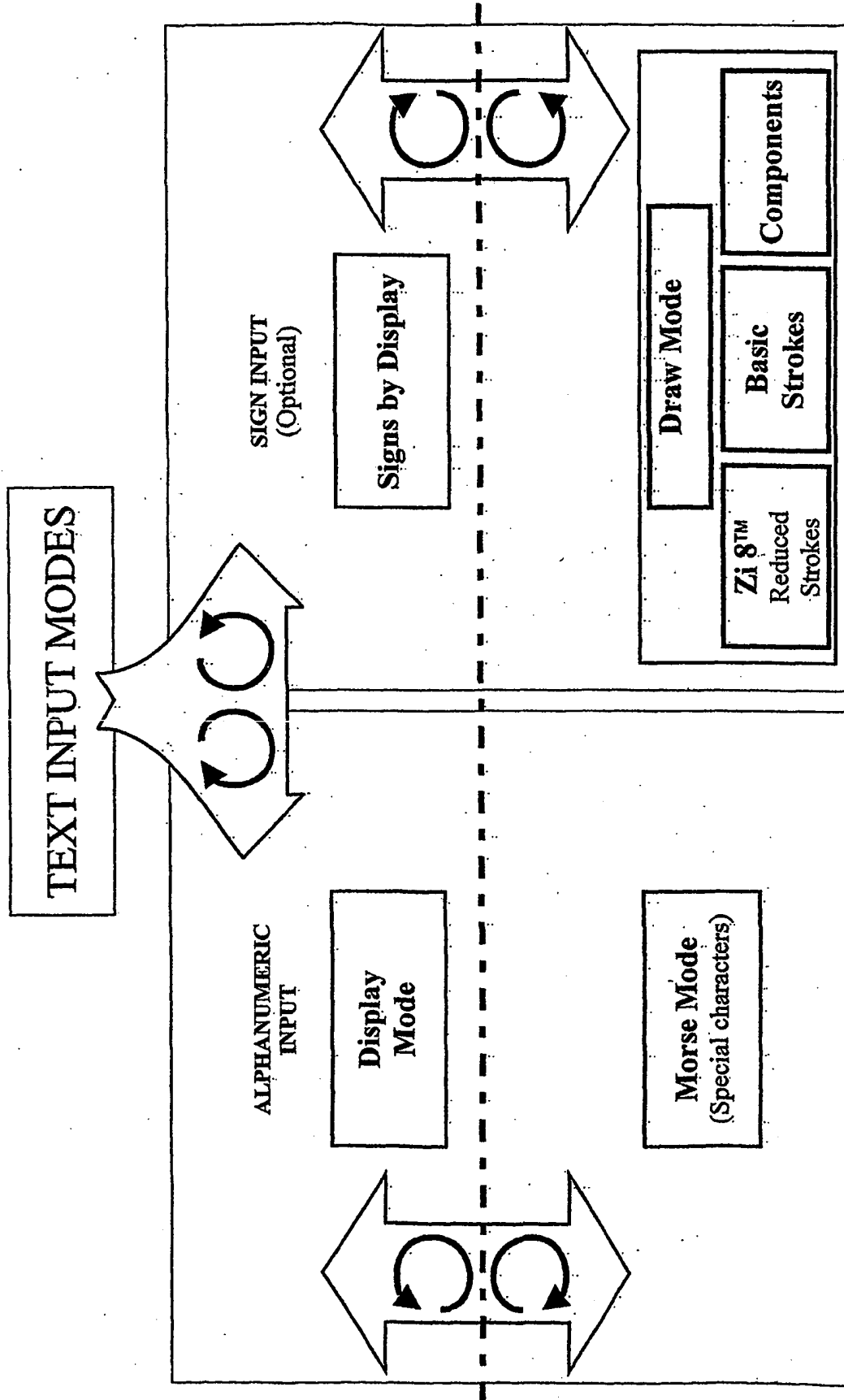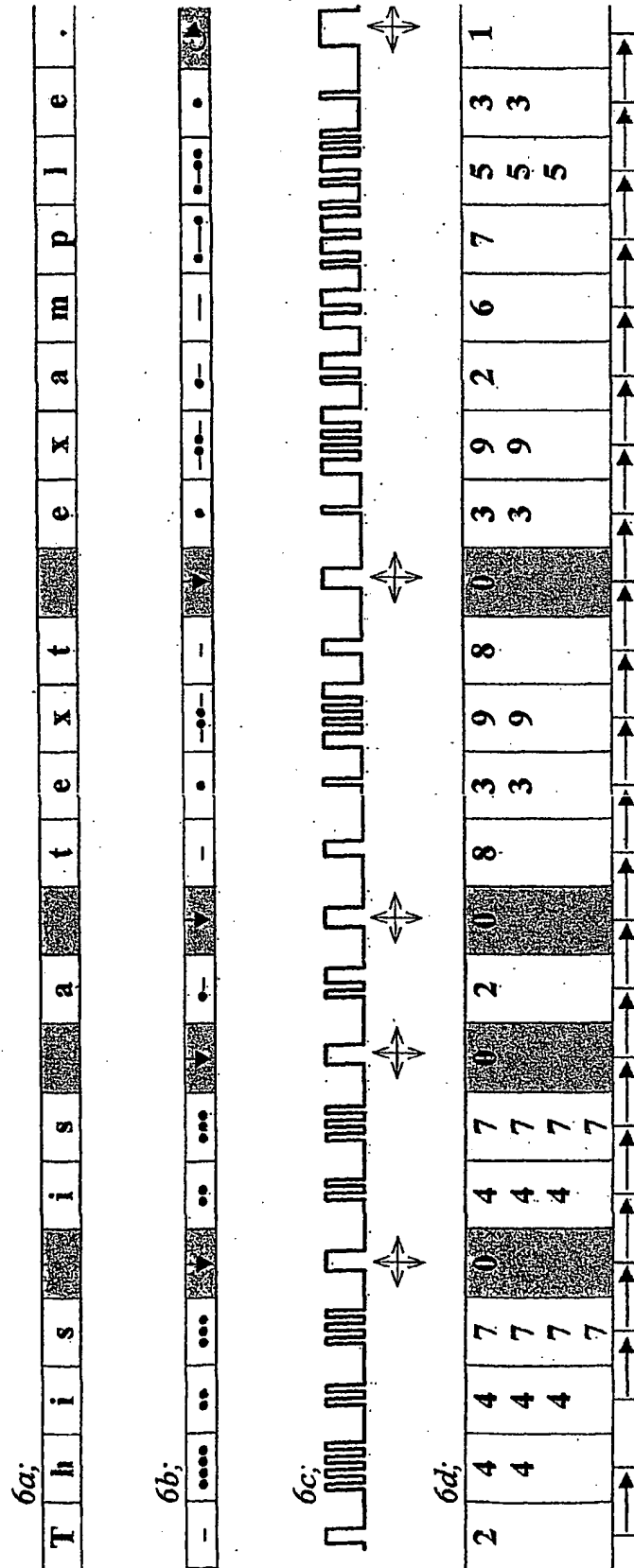
Fig. 4

Fig. 5

TEXT INPUT MODES

SIGN INPUT (Optional)

Signs by Display

Draw Mode

| Zi 8™ Reduced Strokes | Basic Strokes | Components |

ALPHANUMERIC INPUT

Display Mode

Morse Mode (Special characters)

Fig. 6

Fig. 7

Fig. 7b

.	?	!	@	"
1	2	3	4	5
C	D	E	F	G
c	d	e	f	g
á	ã	æ	ø	å
α	β	π	δ	φ

14

15

etc.

Fig. 7a

V
e
r
t
i
c

8

5

10

9

Horizontal Field

1

11

6

7

12

13

Fig. 7c

Character-based Languages	Sign-based Languages
Latin alphabet	Chinese
Greek alphabet	Japanese
Arab alphabet	Korean
Cyrillic alphabet	

11

12

| Mathematics |
| Arithmetic |
| Trigonometry |
| Differentials |
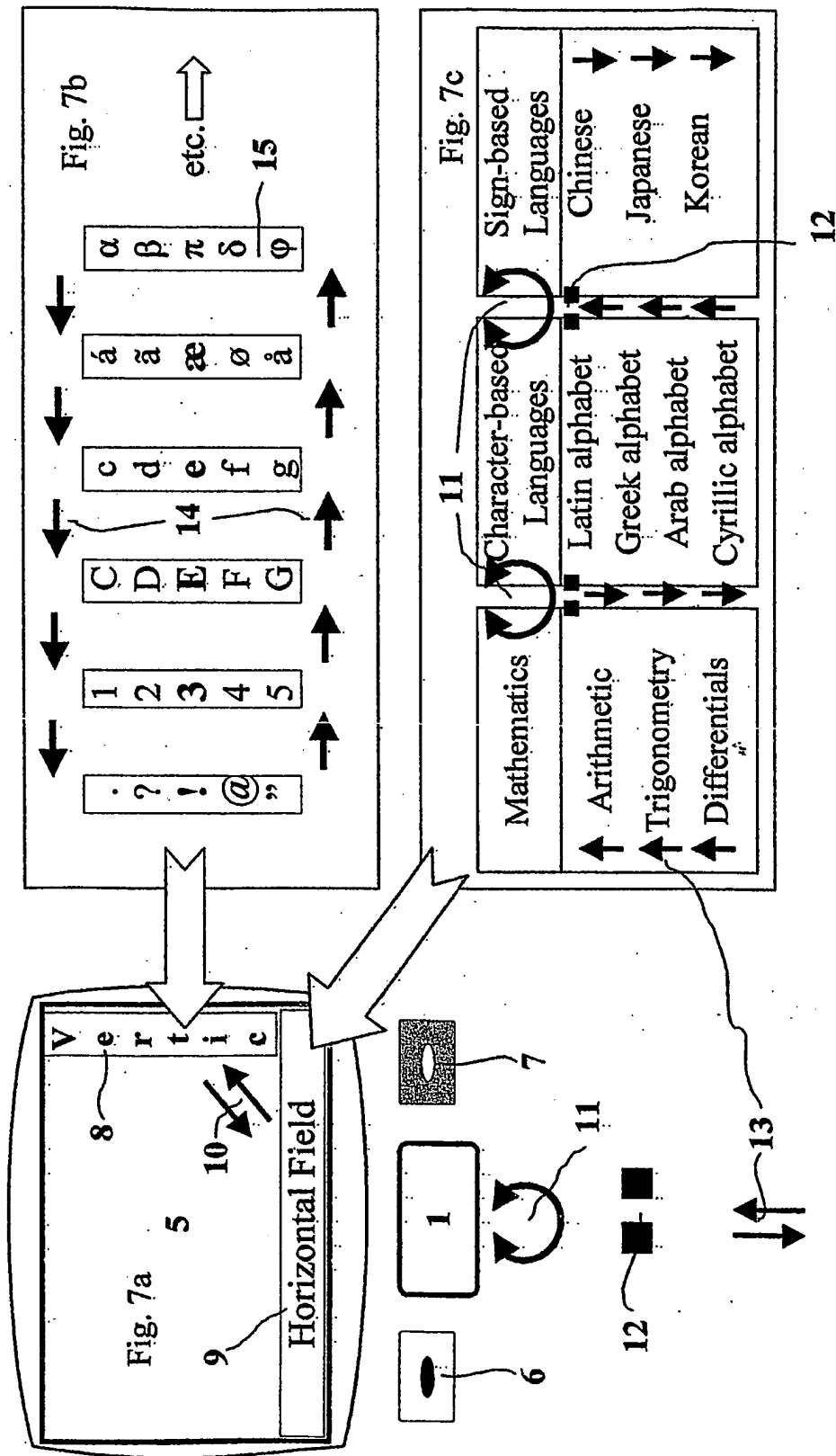
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G06F 3/00, H04M 1/247
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: G06F, G06K, H04B, H04M, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5608395 A (KURTZ ET AL), 4 March 1997 (04.03.97), column 2, line 9 - column 7, line 12, figures 1-2, abstract	1-17
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Y	US 6057540 A (GORDON ET AL), 2 May 2000 (02.05.00), column 2, line 57 - column 9, line 67, figures 1-2, abstract	1-17
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| X | Further documents are listed in the continuation of Box C. | X | See patent family annex. |

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Date of the actual completion of the international search	Date of mailing of the international search report
31 January 2002	0 4 -02- 2002
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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